

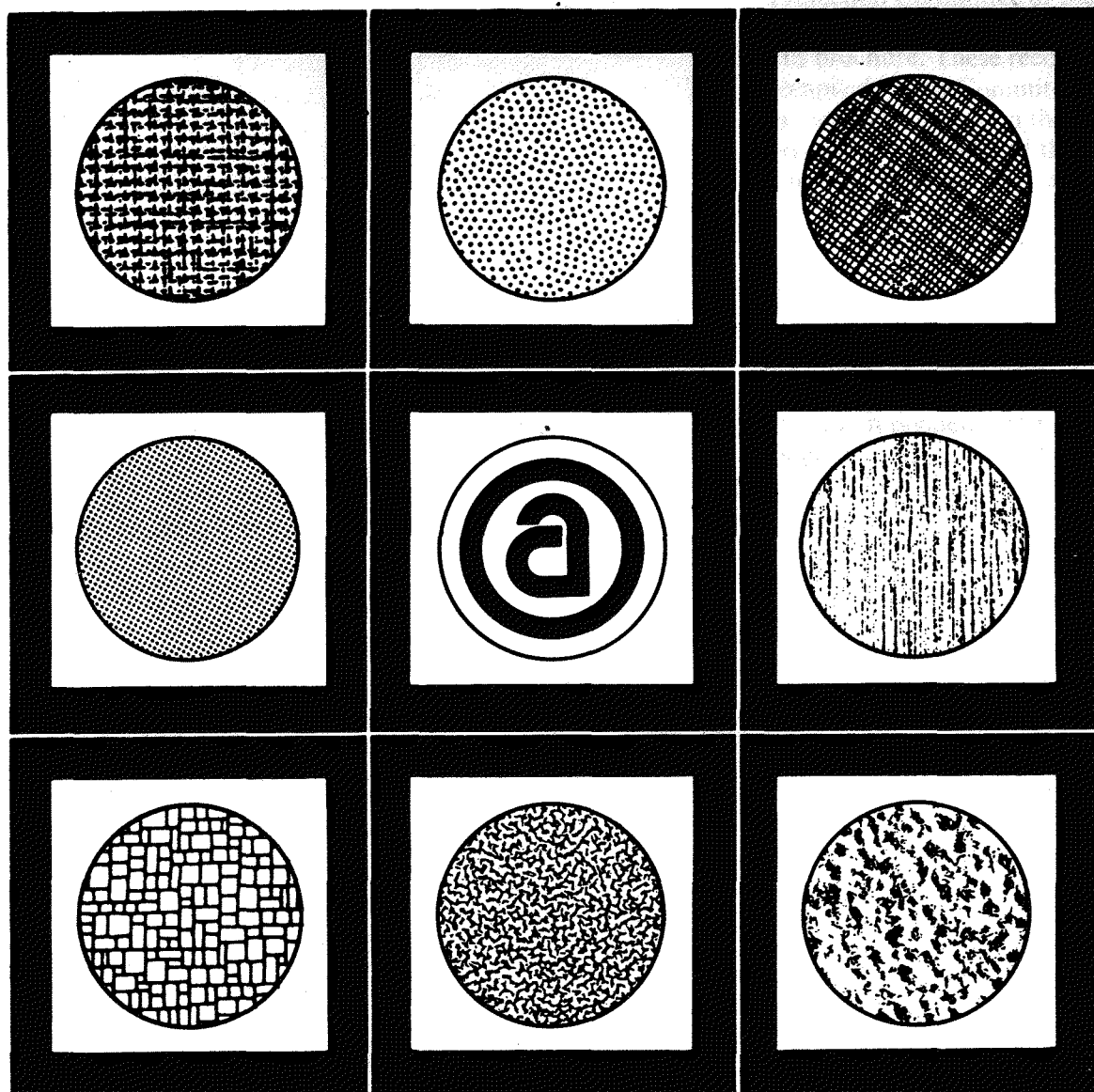
Recommendations for storage and handling of aluminum pigments and powder

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the Aluminum Association



Recommendations for storage and
handling of aluminum pigments and powder



General safety recommendations for storage of aluminum pigments and powders

Aluminum paste and powder can be shipped, stored and used with safety if proper attention is given to the maintenance of scrupulous housekeeping and the basic rules of safety contained in this brochure are carefully followed. However, under certain conditions, aluminum powders and paste can ignite or explode.

In order to provide a better understanding of the recommended safe procedures, the Safety & Property Protection Committee of the Pigments & Powder Division of the Aluminum Association has prepared this brochure. These recommendations were compiled by the Committee from those sources listed in the Appendix, from the technical information presently available and the members' experience in handling aluminum pigments and powders. The Committee believes that if these recommendations are followed, the hazards mentioned in this brochure will be substantially reduced. It must be recognized however, that under some conditions additional steps may be advisable. Likewise, technical advances may uncover better ways of dealing with these materials. If you have any questions concerning aluminum pigments and powders, please contact the manufacturer.

General

- 1 Storage should preferably be in rooms of fire resistive or noncombustible construction if possible.
- 2 Aluminum pigments and powders should not be stored in rooms containing flammable liquids or other combustible materials because of differences in fire fighting methods.
- 3 Stack containers properly with ample aisle space. Keep vertical height to a minimum.
- 4 All electrical wiring should be enclosed in conduit as specified by the National Electrical Code NFPA No. 70 or ANSI CI-1973. All lights should be of the approved type with adequate wire guards.
- 5 Use only approved electrical motors, switches and fuse boxes preferably located outside the storage room.
- 6 Avoid all water in storage rooms. Leaks in steam lines, radiators or roofs should be promptly repaired.
- 7 Exercise good housekeeping. Guard against the accumulation of dust on floors, walls and other construction. Keep all rubbish, such as oily rags, paper, etc., away from rooms.
- 8 Post "No Smoking" signs and enforce rule. Do not use open lights, blow torches, welding torches, or permit open fire in storage rooms.
- 9 Avoid frictional sparks. Do not permit careless metal to metal contact or metal against concrete. In handling aluminum pigments and powders, use nonsparking metal scoops or shovels. Plastic and ferrous metals should be avoided.

Aluminum pigment storage

- 1 Store sealed containers of paste in a dry room at a temperature preferably between 50° F. and 80° F.
- 2 Keep storage room free of excess water vapor or gases and fumes such as lacquer or paint thinners, industrial solvents, acetone, ammonia, etc., which might be breathed into the containers during

temperature fluctuations and cause deterioration of the quality of the pigment.

- 3 Keep containers at least three feet from steam pipes or radiators.
- 4 Keep all containers carefully sealed except when opened for removal of material.
- 5 When a container is opened in storage or on the job for removal of a portion of the pigment, replace cover and reseal to guard against air oxidation, other injurious gases, vapors or possible admission of other foreign material and loss of solvent from the paste.

Aluminum powder storage

- 1 Aluminum powder should be stored in original Department of Transportation approved tightly sealed steel drums or equivalent aluminum foil lined fiber drums.
- 2 Avoid all water in storage as aluminum powder can evolve hydrogen gas and sufficient heat to cause ignition if exposed to water resulting in drum rupture and subsequent fire.
- 3 Open bin storage is dangerous unless the bin is closed, purged, and maintained with an inert gas containing 3% to 5 % oxygen. The gas should contain no carbon monoxide and have a dew point sufficiently low as to insure that no free moisture can condense out or accumulate in the bin.

Aluminum powder handling

Background

Types of Powders:

Aluminum powders can be divided into three broad classifications — granules, flake and atomized. The length or width of a flake particle may be several hundred times its thickness; whereas the length, width, and thickness of an atomized particle are all of approximately the same order, the length dimension probably not exceeding two or three times the thickness dimension. Granules are particles larger than 200 mesh.

This difference in form is important as it greatly influences the characteristics that allow aluminum powders to burn or explode. . . . as will be shown.

Why They Burn:

Chemically, aluminum has an enormous affinity for oxygen. This results in a thin film of aluminum oxide being produced almost instantaneously on the surface of the aluminum when exposed to the atmosphere. The aluminum oxide film is inert and protects the underlying metal from further attack.

When an aluminum powder particle is heated to a certain temperature (known as the "ignition point"), the mass of the particle is so small that the entire particle may oxidize almost instantly. Thus a pile of such particles will "burn". Since flake particles are much smaller in mass and have much greater surface area per unit mass than atomized or granular particles, they will ignite more readily and burn faster than the coarser types of powder.

Why They Explode:

Fine particles of aluminum powder, like some organic powders such as flour, starch and coal dust, are easily dispersed in air where their light mass allows them to remain suspended or "float" in the air. Like particles in a pile, they will burn when the ignition temperature is reached; but when dispersed in the air (mixed with oxygen) in a certain proportion, the burning extends from one particle to another with such rapidity (rate of pressure rise in excess of 20,000 psi/sec.) that a violent explosion results. Laboratory tests by the U.S. Bureau of Mines and others have established the proportions required for an explosion. They extend throughout a wide range, and very little aluminum powder is needed. Very small amounts of energy are required to ignite certain mixtures of aluminum powder and air. In some cases energy as low as 25 millijoules may cause ignition.

Causes of Dust Explosions:

The discharge of static electricity will produce an electric spark that raises the powder particles in its vicinity above the ignition point . . . resulting in an explosion. Electric switches, broken light bulbs, electric motor commutators, loose electric power connections — even a metal-to-metal impact — anything producing a spark can set off an explosion. Even continued metal-to-metal rubbing (as in a dry sleeve bearing) can generate enough heat to set off an explosion.

Basic safety principles to be followed when handling aluminum powders

RULE 1 — Avoid any condition that tends to suspend or float powder particles in the air.

RULE 2 — Avoid every possible action that generates static electricity, creates a spark, or otherwise results in reaching the ignition temperature.

RULE 3 — Where generation of static electricity may occur, utilize every means to minimize it and dissipate it to avoid a spark discharge.

RULE 4 — Take steps to limit the size of a fire or explosion and to hold any resulting damage to the very minimum.

RULE 1 — To avoid any condition that may tend to suspend or float powder particles in the air, carefully follow these precautions:

- 1** Do not allow powder particles to become suspended in the air in a room where aluminum powder is being processed or handled. The less dust in the air, the better as the lower limit is pretty indefinite. It is presently considered to be between .02 and .03 ounces per cubic foot — an extremely small amount. Aluminum dust will ignite with as little as 9% oxygen present, the balance being nitrogen; or 10% oxygen with the balance helium; or 3% oxygen with the remainder carbon dioxide.
- 2** In transferring aluminum powder, dust clouds should be kept at a minimum. Powder should be scooped from one container to another with as little agitation as possible.
- 3** In mixing aluminum powder with other dry ingredients, frictional heat should be avoided. The best type of mixer for dry mixing operation is one that contains no moving parts, but rather affects a tumbling action such as a conical blender. Introduction of inert atmosphere in the blender is mandatory where dust clouds are generated. All equipment should be well grounded.

RULE 2 — To avoid every possible action that generates static electricity, creates a spark, or otherwise results in reaching the ignition temperature, follow these precautions:

- 1 Locate electric motors and as much electrical equipment as possible outside processing rooms. Only lighting and control circuits should be in operating rooms. All electrical equipment must meet the National Electrical Codes for explosion-proof installations. This includes flashlights, portable power tools, and other devices.
- 2 Use only conductive material for handling or containing aluminum powders. Use only nonsparking metal scoops for handling powder. The handling should be slow and deliberate to hold dusting to a minimum.
- 3 **NO SMOKING**, except in controlled designated areas well away from operating rooms.
- 4 No open lights, fires, or sparks allowed in operating rooms or other dusty areas.
- 5 No matches, lighters, or any spark-producing equipment can be carried by any employee.
- 6 No powders should be poured or slid on nonconductive surfaces. Such actions build up static electricity.
- 7 Powders should always be handled gently and never allowed to fall any distance. Remember all movement of powder over powder tends to build up static charges.

RULE 3 — Where generation of static electricity may occur, utilize every means to minimize it and dissipate it to avoid a spark discharge by following these precautions:

- 1 Grounding machinery to remove static electricity produced in powder operations is vital for safety. It should be thoroughly done according to Recommended Practice on Static Electricity, NFPA No. 77; and Dust Explosion Prevention Aluminum Powders, NFPA No. 651, Sections 511, 734, and 912.
- 2 All moveable equipment such as drums, containers, and scoops must be grounded at all times by use of clips and flexible ground leads.
- 3 Investigate the potentials of using an inert gas such as mentioned previously, as it can be valuable in avoiding the hazard of handling powder in air.

RULE 4 — Take steps to limit the size of a fire or explosion and to hold any resulting damage to the very minimum by following these precautions:

- 1 Keep all drums sealed. Both flake and atomized aluminum powders are shipped in D.O.T. approved sealed drums with fully removable heads. Store these unopened in a separate area wherever possible. If stored with such chemicals as sulphur, nitrates, or other strong oxidizing agents, a fire from any cause would present a most serious problem.

When a drum of aluminum powder is opened for loading or inspection, it should be closed and resealed as quickly as possible. This not only assures greater safety against fire from external cause but prevents possible entrance of tramp metal or water from the air. In past instances, sealed drums of flake powder have withstood an explosion and subsequent fire without ignition of the contents of the drum.

- 2 All containers in work areas should likewise be closed and sealed. Only those in actual use should be open at any time.

Fire fighting methods in case of fire

Aluminum Paste

Aluminum paste is an aluminum flake pigment homogeneously incorporated in a solvent such as mineral spirits. The flash point of this solvent is approximately 100°F. (tag closed cup).

- 1 Never use water to put out a fire. Water reacts with hot aluminum dust to form hydrogen and tends to spread the fire.
- 2 Should a fire occur in an unsealed or open container of aluminum paste in storage or elsewhere, the solvent will burn out before ignition of the aluminum flake takes place. If discovered while the solvent is burning, container cover should be replaced and container then moved to an isolated area. A solvent fire can be extinguished by forming a blanket of carbon dioxide over the surface of the paste providing there is no free dry aluminum powder or dust in or about the room. In case there is aluminum powder or dust in the room, either fine dry sand or fine dry cinders (—10 mesh) should be gently sprinkled in the container sufficiently deep to smother the solvent fire. A solvent fire may also be extinguished by carefully and completely covering it with a proprietary dry chemical agent. If the dry chemical agent is applied with an extinguisher, it

must be equipped with a low velocity nozzle to avoid the possibility of dust generation resulting from the disturbance of any dry material. If the solvent has completely burned out and the aluminum flake has ignited, the drum should be carefully isolated and fine dry sand piled around the outside of the container. If undisturbed, a dense crust will form over the surface of the aluminum and extinguish the burning mass. The application of sand to any burning mass of aluminum should be done with utmost care. Avoid the application of sand in such a manner as to disturb the burning material. In the excitement attending such a fire, there is great danger that the sand will be thrown or shoveled into the mass, blowing powder into the air, resulting in a disastrous explosion. *Do not* use liquid extinguishing agents of any kind. *Do not* use a gas which might disturb the powder.

Aluminum Powder

Aluminum powder in bulk is ignitable only with difficulty. However, once suspended in a dust-air cloud, it is readily ignited and very explosive.

The use of fine dry sand, preferably that screened through a 20 mesh sieve, or use of an acceptable proprietary dry extinguishing material, is at present the best known method of fighting incipient fires of aluminum powder. Water streams or liquid sprays of various kinds that vaporize quickly are highly dangerous since the dust is thrown into the air and the ignited particles instantly cause a violent explosion of the dust. For the same reason, any mechanical agitation or disturbance of the burning powder or that adjacent thereto must be avoided. An ample supply of dry fine-screened sand or other approved powder should be kept in covered bins or covered receptacles, each containing about a cubic yard. These receptacles should be placed at a sufficient number of suitable points at or in each building, convenient to reach quickly. These receptacles should be covered and arranged so that the sand can be quickly scooped up by a bucket or shovel. These implements shall be made of aluminum or other nonferrous material.

In fighting an aluminum powder fire, avoid stirring it. All electric power in the area should be first shut

off, then if the aluminum powder is burning quietly in a place where it can be safely isolated, the sand should be carefully ringed around but not dropped on the burning powder, great care being taken to avoid fanning the dust into the air. The powder, when burning quietly, forms a crust which excludes oxygen and gradually extinguishes itself. As soon as the isolation of the fire has been accomplished, the room should be closed, the windows shut, the bottoms of the doors sealed with sand, and the fire allowed to burn itself out.

Water and other extinguishers shall not be used: All liquid, carbon dioxide or foam type extinguishers shall be rigidly excluded from the plant areas storing or processing dry powders to prevent their being used by excited and inexperienced persons during an emergency.

Fire Fighting Organization: The operating crew should consist in part of men trained to combat the fires of the type encountered in these processes, and only these men should be permitted near the area involved by fire. It is preferable that one individual on this crew be responsible for directing fire fighting operations until more senior personnel arrive on the scene. Local town or city firemen, who might be called to the plant in case of fire, shall be thoroughly instructed in the dangers of using jets of carbon dioxide, water, carbon tetrachloride or other liquids in an aluminum powder fire. They should receive positive orders from their superiors, by prior arrangement with the respective officials, forbidding such use in combating any fire in the aluminum storage area.

More detailed information on fire fighting methods can be found in NFPA No. 651, Standard for the Prevention of Dust Explosions in the Manufacturing of Aluminum Powder, Chapter 10, covering fires in aluminum pastes or slurries and fires in dry aluminum powder.

NFPA No. 65-1973 defines the fire extinguishers that may safely be used. Additional information concerning portable fire extinguishers can be found in NFPA No. 10-1972 (ANSI Z112.1-1972).

Appendix

- 1 M. Jacobson, Austin R. Cooper, John Nagy,
Explosibility of Metal Powders, in U. S. Bureau of
Mines Report of Investigation No. 6516.
- 2 National Fire Protection Association, No. 65,
Processing and Finishing of Aluminum, 1973
(ANSI Z12.19-1973)
- 3 National Fire Protection Association, No. 651,
Dust Explosion Prevention — Aluminum Powder,
1972.
- 4 National Fire Protection Association, No. 77,
Recommended Practice on Static Electricity,
1972.

Sources for obtaining these documents:

U. S. Bureau of Mines
4800 Forbes Avenue
Pittsburgh, Pa. 15213

National Fire Protection Association
470 Atlantic Avenue
Boston, Mass. 02210

American National Standards Institute
1430 Broadway
New York, N. Y. 10018

CRESCENT BRONZE POWDER CO. INC.

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PHONE: 644-8124 AREA 312

August 21, 1978

ALUMINUM PAINTS
METALLIC PIGMENTS
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1841 SOUTH FLOWER STREET
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Douglas Aircraft Company
3855 Lakewood Blvd.
Long Beach, Calif: 90846

Attention: Mr. M. J. Veneroso
Dept. C1-725 (52-11)
Materials Handling & Packaging Engineering

Gentlemen:

With reference to your letter of July 28th (C1-725-103), enclosed is a brochure put out by the Aluminum Association that explains in detail their recommendations for storage and handling of aluminum pigments and powder.

We should also like to call to your attention under Section 173.232 of Federal Register #49 Transportation, that "polished aluminum powder which has been treated with oil or waxes for printing or paint purposes is not subject to the requirements of this subchapter." Our interpretation has been that since the aluminum powders we sell are of this type that the Department of Transportation does not require us to label the containers "hazardous solid."

We trust that the above information and the enclosed brochure will give you the information you desire.

Very truly yours,

CRESCENT BRONZE POWDER CO. INC.

Morton Witlin:l

enc.

DPM 2260-200

Alcan Metal Powders

Division of Alcan Aluminum Corporation



Box 290, Elizabeth, New Jersey 07207, Phone: 201-353-4600, Cable: Alcanpwdrs Union N J

July 14, 1978

DPM 2260-20

Mr. M. J. Veneroso
Douglas Aircraft Co.
3855 Lakewood Blvd.
Long Beach, Ca. 90846

re: CL-725-86

Dear Mr. Veneroso:

As a result of extensive testing by the Association of American Railroads, Bureau of Explosives, Edison, N.J. against D.O.T. Definitions, MD 13 atomized aluminum powder is not classified as a hazardous material and therefore, not regulated under Title 49, Section 172.101. The asterisk before, "Aluminum, Metallic, Powder," in 172.101 means that not all forms of aluminum metallic powder are hazardous or regulated under this proper shipping name.

Unfortunately, this distinction is not clearly established in the IATA regulations. As a result, all forms of aluminum powder (hazardous or not) are shipped under Article No. 78. *NOT TRUE!*

Also enclosed is a Material Safety Data Sheet for MD 13 atomized aluminum powder.

In addition, I am attaching the Aluminum Association's, "Recommendations for Storage and Handling of Aluminum Pigments and Powder."

While I believe that this enclosure will describe the fundamental precautions necessary to guard against the trouble in handling aluminum powders and pastes, it is not always possible to be certain that a particular application will not involve a situation needing more specific attention.

If such is the case, I will be glad to go into the matter with you.

Very truly yours,

Harry E. Bell
Harry E. Bell
Technical Mgr.

HEB:dc